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## CLAIMS

1. A fuel cell, comprising:

a membrane electrode assembly (21), and

5 a bipolar plate (24) disposed outside the membrane electrode assembly (21), wherein:

the bipolar plate (24) is porous, and comprises:

a first gas passage (33) formed on a surface on one side of the membrane electrode assembly (21),

10 a second gas passage (35) formed on another surface on the opposite side of the membrane electrode assembly (21),

a communicating passage (34, 81) which allows the first gas passage (33) and second gas passage (35) to communicate with each other,

15 a gas inlet (31) for introducing gas connected to one of the first gas passage (33) and second gas passage (35), and

a gas outlet (37) for discharging gas connected to the other of the first gas passage (33) and second gas passage (35).

2. The fuel cell as defined in Claim 1, wherein:

20 the gas inlet (31) is connected to the first gas passage (33),

the gas outlet (37) is connected to the second gas passage (35), and

gas introduced from the gas inlet (31) flows through the first gas passage (33), communicating passage (34, 81) and second gas passage (35) in that order, and is discharged from the gas outlet (37).

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3. The fuel cell as defined in Claim 2, wherein:

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the second gas passage (35) is formed on the opposite side of the first gas passage (33) so that the second gas passage (35) is back-to-back with the first gas passage (33), and the gas outlet (37) is formed on the opposite side of the gas inlet (31) so that the gas outlet manifold (36) is underneath the gas inlet manifold (32).

4. The fuel cell as defined in Claim 2, wherein the first gas passage (33) comprises:

an upstream gas passage (33a) whereof one end is connected to the gas inlet (31) and the other end is closed, and

a downstream gas passage (33b) whereof one end is closed and the other end is connected to the communicating passage (34).

5. The fuel cell as defined in Claim 2, wherein:

the pressure of the gas flowing through the first gas passage (33) is higher than the pressure of the gas flowing through the second gas passage (35).

6. The fuel cell as defined in Claim 5, wherein:

a differential pressure between the first gas passage (33) and the second gas passage (35), is produced by a pressure loss in the communicating passage (34, 81).

7. The fuel cell as defined in Claim 6, further comprising:

a differential pressure regulating mechanism (82) which regulates the differential pressure by regulating the pressure loss in the communicating

passage (81).

8. The fuel cell as defined in Claim 7, wherein:

the differential pressure regulating mechanism (82) regulates the  
5 pressure loss according to the load of the fuel cell.

9. The fuel cell as defined in Claim 2, wherein:

the communicating passage (34) is a through-hole (34) passing through  
the bipolar plate (24).

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10. The fuel cell as defined in Claim 9, wherein:

the through-hole (34) has a smaller cross-sectional area than the cross-  
sectional area of the first gas passage (33).

15 11. The fuel cell as defined in Claim 2, wherein:

the communicating passage (81) is an external manifold (81) provided  
outside the bipolar plate (24) which allows the first gas passage (33) and  
second gas passage (35) to communicate.

20 12. The fuel cell as defined in any of Claims 2 to 11, comprising:

a cooling mechanism (25) which cools the bipolar plate (24), wherein:

the cooling mechanism (25) cools the bipolar plate (24) so that the  
temperature of the gas flowing through the second gas passage (35) is lower  
than the temperature of the gas flowing through the first gas passage (33).

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13. The fuel cell as defined in Claim 12, wherein:

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the cooling mechanism (25) cools the bipolar plate (24) from the side of the second gas passage (35).

14. The fuel cell as defined in any of Claims 2 to 13, wherein:

5       the cooling mechanism (25) cools the bipolar plate (24) so that the temperature of the gas flowing through the first gas passage (33) is lower, the nearer the gas inlet (31) is.

15. The fuel cell as defined in Claim 14, comprising:

10       a controller (10) which functions to:

regulate the cooling performance of the cooling mechanism (25) so that the temperature of the gas discharged from the gas outlet (37) is higher, the larger the gas pressure or gas usage rate of the fuel cell (11) is.

15   16. The fuel cell as defined in Claim 15, wherein:

the controller (10) regulates the cooling performance of the cooling mechanism (25) so that the temperature gradient of the gas flowing through the first gas passage (33) increases, the higher the temperature or humidity of the gas at the gas inlet (31) is.

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17. The fuel cell as defined in Claim 16, wherein:

the controller (10) further functions to regulate the cooling performance of the cooling mechanism (25) so that the temperature gradient of the gas flowing through the first gas passage (33) increases, the larger the gas usage  
25   rate of the fuel cell (11) is.

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18. A fuel cell, comprising:

a membrane electrode assembly (21),

a bipolar plate (24) disposed outside the membrane electrode assembly (21) and

5 a cooling mechanism (25) which cools the bipolar plate (24), wherein:  
the bipolar plate (24) is solid, and comprises:

a gas inlet (31) for introducing gas,

a gas outlet (37) for discharging gas,

a first gas passage (33c) formed on a surface on the side of the  
10 membrane electrode assembly (21), whereof one end is connected to the gas  
inlet (31) and the other end is connected to a return part (33d), and

a second gas passage (33e) formed parallel to the first gas passage  
(33c) on the surface on the side of the membrane electrode assembly,  
whereof one end is connected to the first gas passage (33c) via the return  
15 part (33d) and the other end is connected to the gas outlet (37), and

the cooling mechanism (25) cools the bipolar plate (24) so that the  
temperature of the gas flowing through the first gas passage (33c) is lower,  
the nearer the gas inlet (31) is.

20 19. The fuel cell as defined in Claim 18, comprising:

a controller (10) which functions to:

regulate the cooling performance of the cooling mechanism (25) so that  
the temperature of the gas discharged from the gas outlet (37) is higher, the  
higher the gas pressure or gas usage rate of the fuel cell (11) is.

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20. The fuel cell as defined in Claim 19, wherein the controller (10) further

functions to:

regulate the cooling performance of the cooling mechanism (25) so that the temperature gradient of the gas flowing through the first gas passage (33c) increases, the higher the temperature or humidity of the gas at the gas inlet (31) is.

21. The fuel cell as defined in Claim 20, wherein the controller (20) further functions to:

regulate the cooling performance of the cooling mechanism (25) so that the temperature gradient of the gas flowing through the first gas passage (33c) increases, the higher the gas usage rate of the fuel cell (11) is.